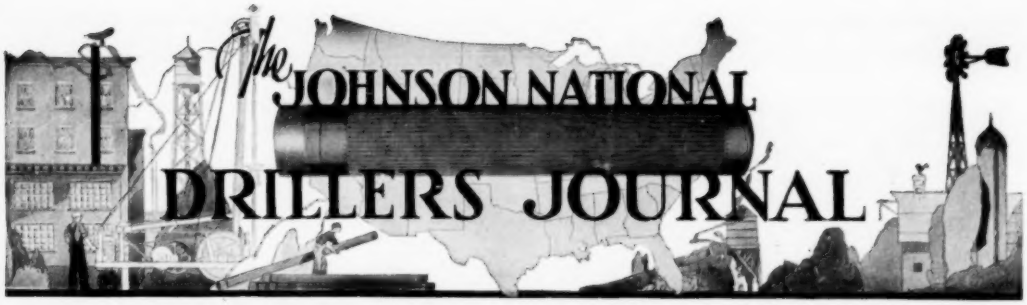

Vol. 24, No. 5 THE JOHNSON NATIONAL DRILLERS' JOURNAL Sept.-Oct., 1952

GROUND WATER RESOURCES AND THEIR CONSERVATION

SILT, SAND, AND GRAVEL
Origin and Description

Practically every well driller who has put down more than one hole has encountered clay, silt, sand, or gravel in some form or other. Many of these drillers have cased out these loose unconsolidated materials rather than try to develop them as a source of water supply. Feeling that all of us could stand it to know more about our silt, sand, and gravel formations, we have been investigating the subject and will give those interested the benefit of our information in the hope it will be helpful to any one interested in developing a water supply in such formations.

Technically speaking, clays, silts, sands, and gravels are nothing more or less than particles of rock that have been broken up and disintegrated by physical and chemical action throughout the years. Every kind of rock that we know of is subject to such destruction and those forces finally determine the shape, size and arrangement of our sedimentary deposits.

Only experts can tell by looking at a rock whether it is the result of physical, chemical, or organic action. As a matter of fact, most sedimentary deposits are the result of one or more of these actions, if not all three. It must be remembered that sediments such as silt, sand, and gravel may have been transported many miles after being separated from their parent rock formation. They may have been blown over long distances by the wind and then deposited on either land or water surfaces. Again they may have been transported by glaciers during which travels they were subject to dissolution by chemical action, grinding up by larger particles or the abrasive action of underlying hard rocks. During these travels sediments were created and graded. Particles of the same size and shape tended to hang together. Oftentimes they were reduced from sharp fragments to round particles as they moved along, and particles of the same size often collected forming stratas varying from fine to coarse.

The material situation, as far as drillers' supplies are concerned, is gradually improving; but this is not true of the drilling industry as a whole as there seems to be a slacking-off of new business in all parts of the country. Drillers are complaining about the lack of inquiries and the customer's tendency to put work off until next year. We see no reason for this, unless every one is holding back until a new administration is elected.

Regardless of the outcome of the election, water will be needed by cities, industries and agriculture, and well drillers will have to install these wells, so it is quite likely that there will be work for all energetic and aggressive drillers.

Sands and gravels may be made up of any kind of rock, but most of them are from the tough hard rocks as the sands and gravels from the softer rocks are soon deposited or broken down into still finer sediments, such as silt and clay. Naturally boulders are typical of our largest sediments and the larger they are, the nearer they are to their original rock sources. By the same token, cobblestones, large gravel down to the finer gravels are found farther from their original source. Gravels and sands that have been transported by water tend to be round in shape with smooth surfaces, while other gravels that have been crushed or have been in contact with hard rock surfaces are scarred and have deep cuts or grooves.

The sorting of gravels as they are laid down varies, but as a rule the coarser or larger particles are found near the bottom of a deposit, with the smaller particles at the top, finally grading into sand. River gravels are the most poorly sorted of all resulting in more or less stratification in the deposit. Beach gravels range from poorly sorted to well sorted without apparent stratification. Glacial grav-

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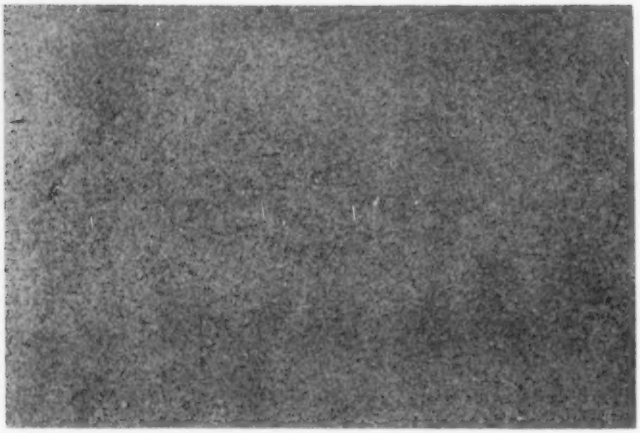


This is "silt" consisting of particles varying in size from 0.002" to 0.0002", or from 1/20 to 1/200 millimeters. Clay is finer than silt.

SILT, SAND AND GRAVEL

(Continued from Page 1)

els are generally sharper and more irregular in shape than either river or beach gravels. Furthermore, the individual particles may be of comparatively large size as they are transported bodily from the original source. When deposited by the melting ice, they are accompanied by much sand, silt, and clay. Such a formation is called till.

Sedimentary deposits made up of smaller particles are the sands and sandstones which like the gravels are derived from pre-existing rock formations. The individual particles range from the size of clay and silt particles up to as much as 5/64 of an inch. In many sand formations all sizes of sand are found from the largest to the smallest and most of them contain silt and clay as well.

From a mineral standpoint the most common constituent of sand is quartz, though the minerals found in sand formations are many. Actually, we have sands whose particles are mostly dolomite, gypsum, magnetite, coral, and shale. Sands like gravels are simply the product of rock disintegration and they may be transported by streams, glacial ice or winds. The windblown or aeolian sands are common in the arid regions of the West and along the beaches of the oceans and some of the shores of the Great Lakes, as along the shores of Lake Michigan. Windblown sands, like those deposited by water, are stratified since they are transported by winds of varying velocities. Naturally windblown sands are finer than water sands.

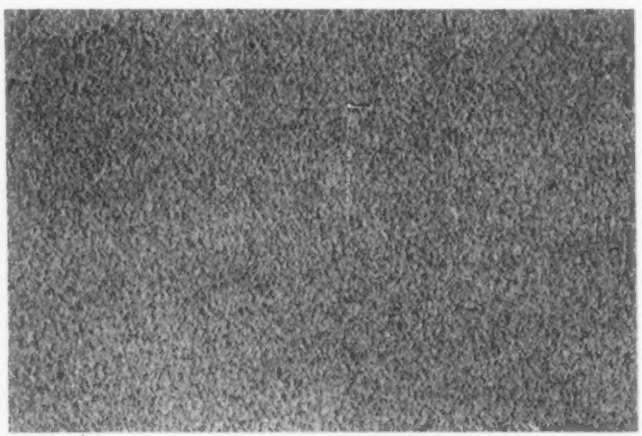
The mineral content of windblown sands varies. Most of them are siliceous, which means they originated from formations predominantly composed of silica. In the Bahamas and Bermudas windblown sands of calcareous (seashells and coral) origin are found and in New Mexico there are extensive deposits of wind deposited sands of gypsum or the sulphates of lime. One author has stated that a non-calcareous sand with more than 50% of the particles well rounded is more likely of wind than water production.

The shape of sand grains is a pretty sure indicator of the distance they have traveled, though this is not of too much importance as all sands are sharper and less rounded than pebbles or gravels. If there is any difference in the shape of sand grains, the windblown are more rounded than the water-laid sands. Glacial sands are usually sharper and more angular than other sands, particularly those found in the upper portions of streams.

A deposit of sand is liable to contain particles of several different origins. This is true of glacial out-washes which may contain particles of sand from rocks of every geologic age up to the present time.

The sorting of sand deposits varies as this depends on a number of factors having to do with the manner in which the deposits were laid down. As a rule, the wind-laid sands are sorted the best, the beach sands are second, and sands of other origin are the most poorly sorted.

As to the texture of sand formations, all well drillers know they



This is "very fine sand" consisting of particles varying in size from 0.004" to 0.002", or from 1/10 to 1/20 millimeters.

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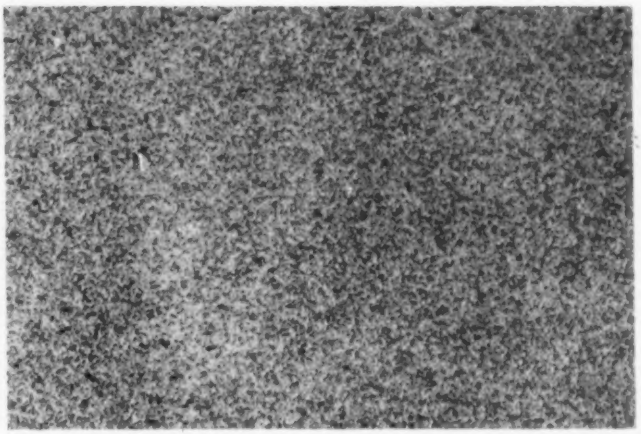
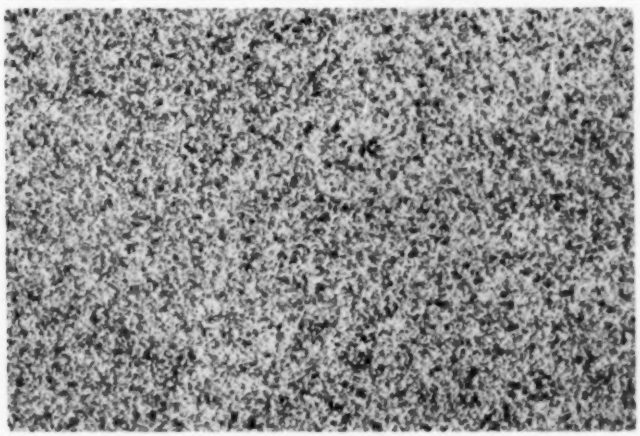
contain cementing or binding substances which tend to bind the sand particles into a solid mass. This not only adds to the drilling difficulties but it affects the water-yielding ability of the formation. The chief cementing agents found in sand formations are the carbonates of magnesium and calcium, iron oxide or rust and silicon dioxide. Occasionally some of the finer clay-like substances are mechanically deposited in a sand formation and they act as a binder.

When the sands of a sedimentary formation have been bound together by a cementing agent, the formation then is known as sandstone. The amount of binding varies as the particles in some sandstones are so solidly bound to each other that the formation becomes solid and hard to drill. In other sandstone formations, there is just enough of the cementing agent to hold the particles together. Such a formation is soft and has a tendency to collapse easily. The dissolving effect of water plays an important part in wells constructed by drilling open holes in sandstone. In such wells the increased velocity due to pumping increases the rate of solvent action and the sides of the drill hole begin to slough off sand. If pumping is continued, the drill hole frequently collapses and fills the well with sand.

The size of the particles in a sandstone vary just as they do in a loose sand formation. The coarser particles often from a conglomerate and the finer particles pass into a shale-like formation. Sandstones are remarkable for their variations in color. Along the Mississippi River we have sandstone that is almost a pure white. In other places we have all shades of pink up to bright red. Yellow and green sandstones are not uncommon. It all depends on the amount and kind of cementing material holding the sand particles together. If the sand particles are of siliceous origin, the formation will be hard and sufficiently durable for building purposes. Most of our sandstones are excellent water producers.



This is "fine sand" consisting of particles varying in size from 0.010" to 0.004", or from ¼ to 1/10 millimeter.



This is "medium sand" consisting of particles finer than 1/64" but coarser than fine sand. Size ½ to ¼ millimeter.

The finer sedimentary formations known as silts and clays are those whose particles are smaller than 2/1000 of an inch, mixed with water they make mud. When found under sufficient pressure, they make up a solid mass having cleavage lines parallel to the bedding and this is shale. Clays and silts are composed of various materials. Thus we have argillaceous clays and shale which are mostly aluminum silicate, sandy shales, and clays which contain a portion of fine sand, calcareous shales and clays containing seashells and coral, iron shales and clays containing various forms of iron, carbonaceous shales and clays containing some form of carbon and bituminous shales and clays containing bitumen, a form of asphalt. Clays and shales are of no value as producers or transmitters of water.

Scientists make a distinction between clays and silts but this is largely a matter of size rather than a difference in materials.

Clays are found in many forms and colors depending on their constituents. Thus we have kaolinite, bentonite, Fullers earth, all products of rock decomposition. Under certain conditions in tropical regions clays decompose into aluminum hydroxide and silica and iron

(Continued on Page 4)

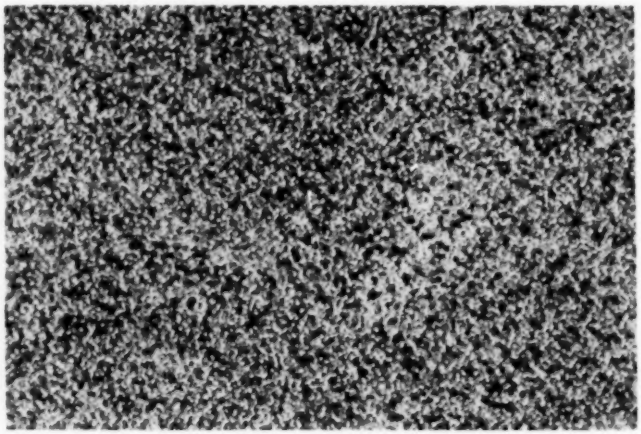
SILT, SAND AND GRAVEL

(Continued from Page 3)

minerals reduced to iron hydroxide. The resulting product is known as laterite. This formation is encountered occasionally by well drillers, as the bauxite deposits of Arkansas are of this type.

A common type of clay is that which has been produced by glacial action. These sediments are the result of grinding, abrasion, and shocks received from the movements of glaciers. Essentially this type of clay is sand or pebbles which have been ground into a fine dust, sometimes called stone dust or rock flour. Clays produced by the action of streams is known as fluvial clay. This type of clay is fine, low in soluble matter and usually is recognized by its dark color. Fine clays are also present on the bottom of lakes. If the lake is in an area of hard water, these sediments usually contain large amounts of calcium carbonate and are generally referred to as muck.

More recently another type of deposit has become of interest on account of its being used as a filtering material in water filters. This is diatomaceous earth which is essentially a deposit of silica oxide formed by evaporation of water and the destruction of small organisms known as diatoms existing in the water. Diatomaceous earth is a soft clay-like material made up principally of the dead shells of the diatoms. It looks like chalk when dry but can be distinguished from chalk by an acid test as it will not effervesce being a siliceous deposit. There are several large deposits of this material in the United States which are being developed at this time. When mixed with clay it makes a good insulating material. A full description of all the clays, silts, muds, and fine sands found in the drilling of wells is beyond our space, but such information can be found in most technical libraries.



This is "coarse sand" consisting of particles varying in size from 3/64" to 1/64", or from 1 to ½ millimeters.

After the description of these sediments probably of more importance to well drillers is information on their water-yielding ability. As a group the clay, muds, and silts are not yielders of water. Most of them can hold water, some more than others, but they hang onto the water they hold. They are tricky and treacherous to work in, as many of them are found in a semi-plastic condition due to the water they hold. Furthermore, just a little water in a clay formation gives it the ability to slip and slide or be squeezed into an open drill hole.

It is in the sand and gravel deposits that water is found. As a group, they are the most prevalent, widespread and dependable formations we have for the development of water supplies. Thousands of municipal, industrial, institutional and irrigation wells depend on these formations for their water supply. Every well driller hoping to bring in a well of large capacity is on the lookout for heavy thick deposits made up of well shaped, well sorted, and large size particles of sand and gravel. Many drillers judge the yielding ability of sands and gravels by their looks and feel and past experience in similar formations. These judgments are oftentimes sufficient to determine whether the well should be built or not; but on the other hand, where the thick-

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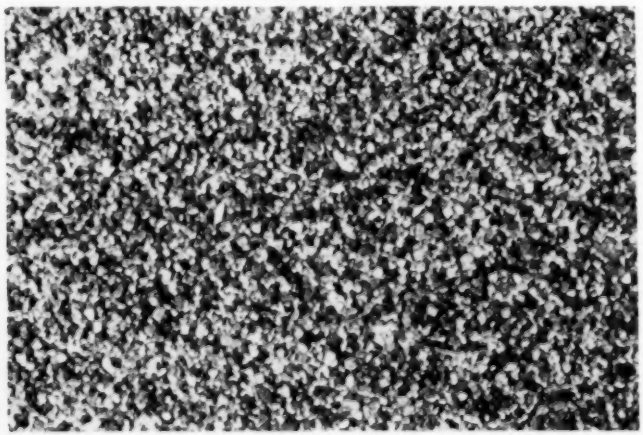

This is "fine gravel" consisting of particles varying in size from 5/64" to 3/64", or from 2 to 1 millimeters.

This is "medium gravel" consisting of particles varying in size from 5/32" to 5/64" or from 4 to 2 millimeters.

(Continued from Page 4)

ness of the deposits is limited, the grading of the particles is a question, the amount of clay a question, the extent of the deposit a question, and the permeability of the deposit a question; then more accurate and detailed information is necessary before judgment can be passed on the probable yield of a formation.

It is then that some knowledge of the origin of the deposit and the type of sands and gravels in it comes in handy. This subject has been discussed many times in the past. It will now be taken up in a different way. There may be some repetition and rehashing of familiar facts, but there still are plenty of questions about sand and gravel formations that c a n n o t be answered.

Most every one judges a sample of s a n d by looking at it in the palm of the hand, feeling its sharpness w i t h t h e fingers and then judging whether it will pass water freely or not. None of these tests will give the information needed, as the most important factors for determining the yielding ability of a sand are not disclosed. These factors are: first, the percentage of porosity or openings; and, second, the permeability or water-transmitting ability of the sample. Both of these factors m u s t be determined by tests which are not readily made nor understood by the average well owner or well driller.

The porosity of a sand sample depends on several things, such as the shape and arrangement of the particles, the amount of cementing, the percentage of particles from the smallest to the largest. These things can only be determined by a mechanical s i e v e analysis, followed by an actual test for the amount of water a given volume of the sample will hold.

It is well known that a well sorted sample of clean sand and gravel has a high porosity, or, in other words, a high percentage of openings. If, however, the sample is not well sorted and contains particles varying from extremely fine to extremely coarse, the percentage of openings between the particles is reduced and it will have a low porosity. Glacial drift is a good example of a sedimentary d e p o s i t w i t h low porosity, whereas outwash sand and g r a v e l deposits from the same origin are usually highly porous and transmit large volumes of w a t e r e a s i l y. The amount and effect of cementation is always h a r d to determine by looking at a sample.

Many people however judge a sand sample by its l o o k s. This means they see the larger particles and not the smaller ones filling the open spaces between the particles. Actually a mixture of small particles of sand all about the same size will have about the same porosity, as a mixture containing particles ten times larger, so long as the particles making up the mixture are all about the same size. Such a mixture is called a uniform mixture. If the size of the particles in a mixture vary from fine to coarse, then it is a graded mixture. The degree of uniformity or grading in a mixture determines its porosity. The size of the particles also determines the number of particles in a given volume and the surface area of the particles. Surface area of the particles also determines the amount of friction that will be encountered by w a t e r flowing between the particles. On the whole,

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This is "coarse gravel" consisting of particles varying in size from 5/16" to 5/32" or from 8 to 4 millimeters.

NASSUA COUNTY N. Y. CONSERVATION

Rockaway Road recharge and impounding basin Garden City, New York, Nassau County Department of Public Works Water conservation program.

Nassau County, on Long Island, New York, is one of the leading communities in this country in providing for its citizens an environment which will make for better citizens, better living conditions, and a better future.

Endowed by Nature with plenty of underground water of the best quality, this community is fully aware that its water supply must be developed carefully and used beneficially, otherwise salt water may be drawn in from the ocean. Practically all of the public supply wells obtain water from the Magothy and Lloyd formations which are found at depths of 300 to 1,200 feet. The population of Nassau County is approximately 600,000 of which 300,000 were added in the last ten years. Such an increase as this has naturally affected and added to the problems of the Water Department.

For this reason the Division of Sanitation and Water Supply Department of Public Works for Nassau County, under the leadership of Senior Engineer W. Fred Welsch, have recently put down a series of deep observation or outpost wells in co-operation with the U. S. Geological Survey. The purpose of these wells was to determine the exact underground conditions in various parts of the county by obtaining samples of the water-bearing formations, observing the movements of the static water levels and determining the salinity or salt content of the underground water. Several of the observation wells will be tested by electric logging and the results compared with formation samples in order that all of the information possible can be collected and studied for future developments.

That such precautions are necessary has been demonstrated already. In 1944 a well in the Lloyd formation at the Port Washington Water District with a pumping level 22 feet below sea level pulled in salt water. This led to abandonment of the well and restrictions being placed on other pumping wells by the New York Water Power and Control Commission.

In 1947 the New York Water Service Corporation had to abandon its wells in the Flatbush (Brooklyn) area due to overpumping bringing on salt water intrusion. These wells supplied ground water to 450,000 people. A new supply had to be brought in to replace the supply of the contaminated wells.

As a matter of fact, Nassau County commenced its investigation of ground water in co-operation with the U. S. Geological Survey in 1932 and had in operation about 350 shallow observation wells when it was decided to put down the deeper outpost wells. These new wells are in the vicinity of Atlantic Beach, Baldwin, Cedarhurst, Oceanside, and other locations all along the coast.

While this is being done to protect the ground water supply, steps have also been taken to conserve the surface drainage by means of large artificial recharge basins on the surface. Already millions of gallons of storm water that would have been wasted has been collected and recharged into the ground formations. This program was started in 1936 by the County Board of Supervisors and at this time plans are being made for additional recharge reservoirs as they are needed. These reservoirs are designed to intercept rainfall and snowfall, filter out the debris and permit the accumulated water to percolate into the underlying formations.

This work in protecting the water supply of Nassau County is carried out along scientific lines and in accordance with the best methods yet devised for the conservation of water.

As a matter of fact, all activities of the County which include parks, golf courses, clubhouses, nature trails, county roads, county sewage system and disposal, county mosquito control, fire, police and health protection, are carried out with the highest standards and maintenance. Surely this will be repaid to the public in the years to come in increased property values and the knowledge that all requirements are being met to protect the health and welfare of the people of Nassau County.

—o—

THE WORLD'S LARGEST INDUSTRY

Many people do not realize that the business of furnishing water is without question our largest and most important industry. Waterworks people, particularly well drillers, are not prone to shout their wares from the housetops, still every one of us is dependent on this industry for our very existence.

If you were to name our largest industries, probably steel would take first place, with oil coming next, followed by railroads, coal and other large industries. Agriculture,

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with all of its various products, would be high up on the list. A recent estimate of the tonnage produced by the steel, oil, coal, and agricultural products is about 1,500,000,000 tons. The same source estimated that the public water systems alone produced some 13,600,000,000 gallons of water daily. This volume of water is the equivalent of about 57,000,000 tons per day or about 21,000,000,000 tons per year. This is about one and one-half times the tonnage of the products of four of our largest industries.

The figures do not mean anything without further consideration. Suppose a family of four uses water at the rate of 100 gallons per day per person (this is not quite the average for U. S. public supplies.) This is 400 gallons for the family or about 3300 pounds of water, costing maybe ten cents per ton delivered in the home, or in other words, a little over two cents per person for a vital product. There are no middleman's profits as the producer delivers the water whenever you want it, pure and ready for use. Compare this with the cost of a similar weight of steel, oil products, farm products, or coal, and you will have some idea of the cheapness of water.

That this is possible is due entirely to the efforts of engineers, manufacturers and operators of waterworks systems. Not much is known of our earlier water systems, except that they were entirely inadequate and a source of typhoid and cholera. After the Civil War our public water supplies began to spring up all over the country and the waterworks industry as we know it today had its beginning. In 1877 there were about 400 public water supply systems operating, delivering about 60 gallons per day per person. Today there are over 16,000 public water systems supplying about 100,000,000 people with an average daily demand of 130 gallons per person.

Wells have changed from the old open bottom wells, walled up with masonry or wood, to the modern small diameter well properly screened and developed. The use of drive points scattered along a suction line for public supplies has been almost entirely discontinued. The use of small wells along a suction line is only resorted to when the conditions are such that no other type of well can be used. In the early days deep rock wells were large enough in diameter to accommodate cylinders far down in the well. These were often operated through pumping rods connected to steam engines at the surface.

Shallow wells were equipped with duplex or triplex displacement pumps operated by belt driven and steam power. These pumps were either horizontal or vertical in operation depending on the well conditions.

The advent of vertical centrifugal pumps and their adoption to deep well pumping introduced pits into the picture and for a while this type of installation was popular. The next step forward was the development of the deep well turbine. This did away with the deep pits and is now the most generally used type of pumping equipment. Improvements in motor and engine drive kept pace with the improvements in pump design.

Purification of public water supplies started about 1880 when rapid sand filters first came into use. The use of chemicals and filter plant was unknown, but in fifty years the art of treating water was so advanced that the early filters are now replaced by carefully designed treatment plants, requiring skilled operators and constant supervision.

Seventy-five years ago the use of cast iron pipe for distributing water was common. It still is as this material has proved its worth in practically every distribution system in the country. However, a number of improvements has been made since then in the design and manufacture of cast iron pipe. Originally all cast iron pipe was cast in stationary molds. Now much of it is cast in molds which are rotated at high speeds. This is known as centrifugal casting. Bells and spigots have been redesigned, wall thicknesses standardized, and protective coatings developed which make cast iron pipe still the most popular pipe for distribution systems. Steel pipes have been tried and used in certain applications, as has concrete pipe.

Measuring devices have been invented and then improved until nowadays every plant operator knows what he is producing and every user knows what he is consuming. There is no end to the developments and improvements being made in the waterworks field. Well drillers play their part in this and should be able to point out to their customers the importance of their work in the waterworks industry.

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Yes, life begins at forty. Also arthritis, stomach ulcers, bifocals, bellyache, gall bladder, colic, hay fever, toothache, and an inclination to talk continuously about the good old days.

Overflow spillway and recording instruments Rockaway Road recharge basin, Garden City, New York, Nassau County Department of Public Works. Water conservation program.

JOHNSON NATIONAL DRILLERS JOURNAL

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W. M. Bollenbach—
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TOM'S COLUMN

Dear Fellows:

Well here we are again and I'm tellin' you there never was a nicer fall day than I'm lookin' out on right now. Me and the boy are fixin' to go out fer a little grouse shootin' this week end, and I'm hopin' this nice balmy weather keeps up for a while. Maybe we won't bother the birds much but it will be one way of gettin' beyond the reach of the political speeches that are startin' to rattle people's ear drums now days.

Well as the fellow said no matter how many years you've been workin' in a line of business there's always something you aint yet learned. We got a call last week from an outfit who was having trouble with a well and they asked us to look into the matter to find out why it was failing. In talkin' with the manager of the concern we found that he had talked to another driller about his problem an' the only recommendation he got was to put in a new well. The manager said he couldn't believe that was necessary because they'd gone to big expense in buildin' the present one, an' felt that what was needed was to get some expert to find out what was causin' the trouble an' then go ahead an' remedy it. We made an examination of the whole setup an' found that all that was needed was a cleansing operation and recommended acid treatment. Well, it so happened that this fellow never heard of acid treatin' and was interested in findin' out all about it. So we outlined for him the method we thought would accomplish what he was after an' explained the use of acids and some of the new detergent chemicals that are now available. The screen in the well is a high grade copper alloy, an' we told him we figgered, by following proper procedures, we could likely get back the original capacity of the well without removin' the screen. Well, he says can you do it without damagin' the screen an' we told him we figgered we could. He then told us that the other driller he'd talked to told him there was no way to do anything about the screen without jerking it, an' he told them in the long run they'd save money by replacin' the whole caboodle. He said that any type screens oughta be replaced every so often anyway. We pointed out that some smaller diameter wells are equipped with drive point type screens that can't be acid treated without damage, but there are drive points available which can be acid treated in the well without pulling out. He asked us if that was more costly, an' we told him yes, but the difference was only peanuts when you consider puttin' a well out of commission for several days every few

(Continued on Page 9)

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William Wright, Vice-President.....Dyer

New England
Edwin H. Hartley, President.....Turners Falls, Mass.
Vincent Sullivan, Secretary.....Oakdale, Mass.

New Jersey
Fred Bock, President.....Rochelle Park
Chas. Greenhalgh, Secretary.....Lakewood

North Carolina
R. O. Heater, President.....Raleigh
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North Dakota
Alfred Jaeger, President.....Mooreton
Fred V. Sletvold, Sec'y-Treas.....Oakes

Northwest
M. West, President.....Salem, Oregon
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Ohio
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Oklahoma
Marvin Baker, President.....Piedmont
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W. L. Field, President.....Vineland
L. W. Kidd, Sec'y-Treas.....Tillsonburg

Oregon
Ed Steinman, President.....Portland
Art Gaunt, Secretary.....Aloha

Pennsylvania
EASTERN DIVISION
John H. Rulon, President.....Philadelphia
Thomas Magee, Secretary.....Philadelphia 25
WESTERN DIVISION
Owen W. Lininger, President.....Greenville
Mrs. Muriel Butcher, Secretary.....Washington

Rhode Island
D. O. Hamilton, President.....Portsmouth
D. E. Whelan, Secretary.....Providence

South Dakota
Martin Sather, President.....Presho
Harold Norbeck, Secretary.....Redfield

San Joaquin Valley (California)
Jack De LaGrange, President.....Madera
Glen V. Slater, Secretary-Treasurer.....Fresno

Texas
O. F. Jensen, President.....Houston
Geo. Ringstaff, Secy.-Treas.....Houston

Virginia
J. G. Perry, President.....Richmond
Jack Sundquist, Secretary.....Norfolk

Washington State
Oliver F. Zinkgraf, President.....Spokane
O. E. Erdman, Sec'y-Treas.....Elma

Wisconsin
Beck Goldbeck, President.....Appleton
Ralph H. Nienow, Executive Secretary.....Merrill

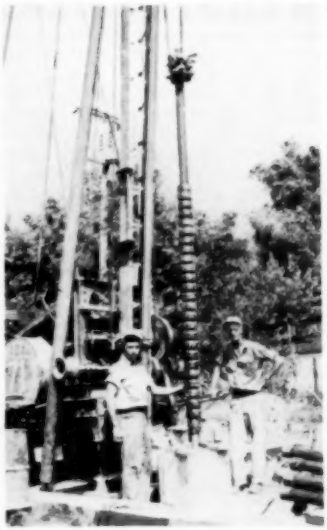
(Continued from Page 8)

years. That made sense to him an' he was much relieved when he found out a good job could be done without the buildin' of a new well.

Since then we've talked to some of the boys an' was surprised to learn that a lot of drillers don't realize what can be done along the line of rehabilitatin' a well. Some of 'em have never given any thought to carryin' a line of acids an' detergents. We been doin' it for some years now an' I thought most of the boys in the business did likewise. There are several that ain't harmful to metals and darned effective when it comes to screens stopped up by fine sand an' clay stoppages.

Of course I figger you got to know what to do with these materials. I know at first we thought all we had to do was to throw the chemical in the well an' let it work a while and then pump the well out. But we discovered it ain't that simple—in some cases it may take several treatments of the chemical, an' they should stand in the screen fer a length of time that will do the business. Sure there's a technique in doin' this sort of work just like there is in everything a driller has to do. When a driller gets familiar with the use of chemical treatments he can guarantee results in most cases once he knows the kind of screen an' equipment he's got to work on. A customer is more likely to have confidence in a driller who can come up with a remedy such as this when trouble develops—it sure helped us get a good standin' with this manager I'm telling you about. But it ain't only the good will that's involved, it opens up a lot of good income than can be handled on the off days. I guess too many of us figger that when a customer calls us in fer some advice we oughta finagle some way to sell him on a new well. Our experience proves that by showing him you're mainly interested in giving him the benefit of your experience an' know how in maintainin' his water supply pays out best in the long run. In these days of high costs every well owner is grateful fer whatever we can do to point out economical ways of gettin' the needed work done.

In the case I been talkin' about we managed to do a good job an' the well is back producin' capacity right now. Don't tell me we lost anything by steerin' this customer right—he's gonna rely on our service from here in.



Omaha Drilling Company setting a 24-stage pump at Worthing, South Dakota, using a 71 Speed Star rig. H. E. Hickman on the left and G. W. Brown on the right.

Speakin' of chemicals—you can get all the information you want through your supply houses. I sure recommend lookin' into the matter because it's an important part of our equipment an' our job.

Well boys the hills an' the trees an' the woods is beckonin' so I'll pick up the old blunderbuss an' do a little blastin'. There oughta be plenty work this year, so things are lookin' pretty good. The best of luck to all of you.

Yours truly,

TOM.

—o—

A small boy, with a penny clutched tightly in his hand, entered a top shop. After a few minutes the proprietor, driven to distraction after showing him most of the stock said:

"Look here, my boy, what do you want to buy for a penny, the world with a fence around it?"

Boy: "Let's see it."

SILT, SAND AND GRAVEL

(Continued from Page 5)

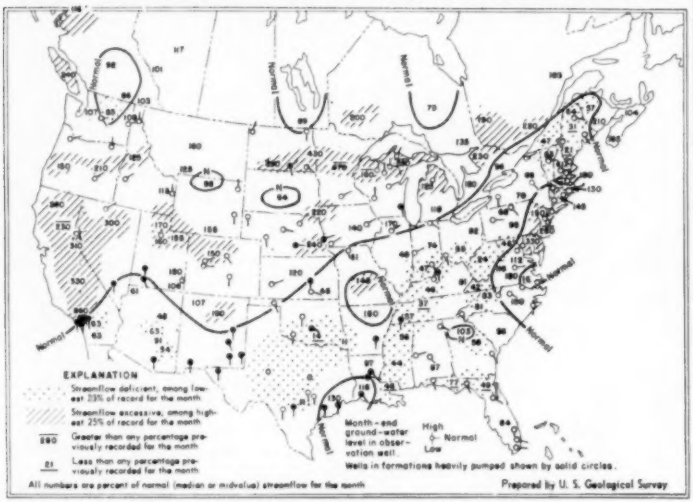
silt and clay are about the same porosity as sand and gravel, but no one would expect to get water through a silt and clay formation, even though it had a high porosity. Field tests of porosity are not too hard to make, however, the results are approximate and of no practical use. To make such a test, select two containers of the same size, fill one with the sample to be tested, and the other with water. Then pour the water into the sample until it will hold no more. The portion of water remaining can be calculated which subtracted from the total will give the portion poured into the sample. This is roughly the percentage of porosity.

In order to determine the grading of a sand sample, it is passed through a set of sieves of various sizes. The portion of the sample on each sieve is then determined. This is a sieve analysis. From it the largest size particle in the sample can be determined, also the smallest, and what proportion of the sample is retained on each sieve. The analysis will also tell the size of the particles making up 40% of the coarser material. It will also tell us the size of particle of which 90% of the sample is coarser. The 40% size divided by the 90% size gives us a figure called the uniformity coefficient. The 90% size is also the effective size of the formation for hydraulic calculations. The uniformity coefficient is in reality a figure which gives the uniformity or degree of grading of 50% of the sample. The effective size is a figure which tells whether the mixture contains small particles or large particles. Thus a sand mixture can be described for size and grading just as easily as a pair of shoes or suit of clothes. The uniformity coefficient is also an indicator of porosity as the higher the coefficient the lower the porosity. Mixtures made up of particles all the same size have a uniformity coefficient of 1.0, while mixtures having all sizes of particles have uniformity coefficients up to 10.0 or more.

As for porosity, this varies from sediments of no practical porosity up to 50% or more. Newly depos-

(Continued on Page 11)

SURFACE and GROUND WATER CONDITIONS


EXPLANATION
Streamflow deficient, among lowest 25% of record for the month
Streamflow excessive, among highest 25% of record for the month
Greater than any percentage previously recorded for the month
Less than any percentage previously recorded for the month
Month-end ground-water level in observation well
High
Normal
Low
Wells in formations heavily pumped shown by solid circles.
All numbers are percent of normal (median or midvalue) streamflow for the month
Prepared by U. S. Geological Survey

STREAMFLOW AND GROUND WATER IN RELATION TO NORMAL FOR THE MONTH, AUGUST 1952

Water Resources Review, July Report, published by the U. S. Geological Survey, says that the water supplies in New England and the southeastern states have not yet been hit by drought, although lack of rain and high temperatures have caused extensive agricultural losses. Runoff was predominantly deficient in those areas, but minimum flows were generally well above minimums previously recorded. Ground water levels were mostly in the normal range and reservoir storage was not critically low.

In the Southeast runoff was deficient generally but ground water levels were mostly in the normal range and stream flow for the most part was well above previous lows. In Virginia drought conditions existed at the end of the month and several municipalities found it necessary to restrict water use.

In Kentucky ground water shortages developed where limited ground storage was available, such as shallow wells in limestone. Stream flow was low in Tennessee, which with lack of rain and high temperatures caused extensive agricultural damage. In the heavily pumped Memphis area, ground water levels reached a new low for July, while consumption rose to 10 or 15 m.g.d. over that of a year ago. In North Carolina ground water levels were about normal, except in the Tennessee River basin. Ground water levels and runoff were far below normal as they were in Florida.

Better conditions were found in the northern mid-continent area, with high ground water levels and excessive runoff in Michigan. High levels were observed in Wisconsin key wells, with the exception of the heavily pumped Milwaukee area. Farther south drought conditions were approached in some sections.

In the West runoff and ground water levels for the most part were in the normal range.

In the August report note was made of the drought continuing in Texas and Oklahoma. Ground water levels were generally below average in the south-central part, the southeast and northern New England.

Ground water levels in Maine at the end of the month were generally below normal. The reverse was true in Connecticut as ground water levels there were generally slightly above normal.

In upstate New York ground water levels continued their seasonal decline, while on Long Island, despite heavy precipitation, water levels in shallow water table wells showed only slight rises and declines during August. Water levels in the deeper water table wells declined, reflecting the sparse precipitation during July. Ground water withdrawals for supplemental irrigation on Long Island were sharply reduced during the month owing to rains falling at the right time.

In Kansas ground water levels continued to decline during August in spite of above normal precipitation. Shortages of water for all purposes were reported from many parts of Oklahoma, with storage in all important reservoirs unusually low. The drought continued in Texas with water levels in key wells at or near record lows. In the Northwest runoff was mostly above normal with ground water levels generally above average, except in heavily pumped areas. Near Milford, Utah where there had been heavy pumping, the water level in a key well was the lowest during thirteen years of record. Ground water levels in northern and western Nevada remained above normal, though they reached new low stages in the Las Vegas and Pahrump Valleys during August.

A Sullivan rotary drill operated by Fred E. Butler of Casper, Wyoming, drilling stock water wells 300 to 700 feet deep out of Thermopolis, Wyoming.

SILT, SAND AND GRAVEL

(Continued from Page 9)

ited material in the delta deposits of the Mississippi River have a porosity of 80% or more. Porosities of 40% in sand and gravel mixtures are rare, as they usually run from 25% to 35%. A porosity of 5% is regarded as low, while 20% is high.

For the purpose of grading granular materials, the Bureau of Soils has adopted the following sizes:

	m.m.		inches
Coarse gravel	8	-4	0.312-0.157
Medium gravel	4	-2	0.157-0.079
Fine gravel	2	-1	0.079-0.039
Coarse sand	1	-0.5	0.039-0.020
Medium sand	0.5	-0.25	0.020-0.010
Fine sand	0.25-0.10		0.010-0.004
Very fine sand	0.10-0.05		0.004-0.002
Silt	0.05-0.005		0.002-0.0002
Clay	Less than 0.005		0.0002

The consulting engineer and well driller are continually encountering problems in handling sediments such as the sands and gravels. There are few places where wells are drilled where there are not problems having to do with caving drill holes, quicksand or water-bearing formations that must be screened and then properly developed.

A thorough knowledge of the sediments and careful examination of them during the drilling operations can prevent much trouble and grief, and by indicating the proper type and manner of well construction, may make the difference between a good well and a bad one.

The driller must be able to recognize the type of sediments containing sand and gravel in his area. For instance, the wind-blown sands in desert areas may be a source of ground water, though salt water is often found in these areas due to the saline deposits common to desert areas.

In areas where the sediments are of glacial origin some of the best water-bearing formations are found. In the areas covered by the glaciers in New England and in most of North America, underlain by crystalline rocks, glacial deposits are the only source of ground water for wells of large yield. In northeastern North Dakota and northeastern Montana glacial deposits are the only source of ground water supply whether large or small.

Till which is a glacial deposit is not so good as a water producer though local beds of sand and gravel may give good yields. The sand and gravel deposits of the middle-west and those found in pre-glacial buried valleys are the best and most important sources of ground water. An example is the buried valley of the Rock River in southern Wisconsin and northern Illinois, the water supply of Dayton, Ohio and McPherson, Kansas. The problem of locating ground water supplies in glacial deposits requires considerable knowledge of glaciers and their movements. In the southwestern part of the country, the sediments are entirely different from the clean sands and gravels of glacial origin. These deposits were created by sudden floods which deposited large quantities of relatively coarse material along the banks of the major streams and then were overlain by finer sediments which filled the voids of the coarse material. Such deposits were often intermixed with material of desert origin, the result being a mixed up jumble of material which as a whole is not a good yielder of water. The Toole Valley in Utah is a good example of this type of deposit.

The sediments laid down in stream channels and on the flood plains of streams are usually more widespread and contain relatively clean sand and gravel, grading from fine to coarse material. These deposits make excellent sources of ground water and are often called glacial outwash. Typical are the deposits in the valley of the Ohio,

(Continued on Page 13)

Outpost observation well being drilled for Nassau County, New York, water conservation program by C. W. Lauman & Company, drilling contractors of Bethpage, New York. Mr. W. Fred Welsch, Senior Engineer, Department of Public Works, Mineola, New York, is in charge for the Department of Public Works.

ASSOCIATION NEWS

This section is devoted to the exclusive use of water well drillers' associations, both state and local. Notices, announcements, changes of officers and other items should be sent to The Editor, Johnson National Drillers' Journal, 2304 Long Ave., St. Paul, Minnesota.

COLORADO MEETING

The time of the annual meeting of the Colorado Water Well Contractors Association originally set for November 13 and 15, has been changed to November 7 and 8. The meeting will be held at the Shirley-Savoy Hotel in Denver. Mr. Lafe Holden of Hudson, Colorado is Chairman of the Convention Committee.

Anyone interested in the arrangements may write to Mr. Holden or to Mr. Thomas P. Ahrens, Secretary, Box 1205, Denver, Colorado.

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OKLAHOMA MEETING

The 4th annual convention of the Oklahoma Association will be held October 30 and 31, Thursday and Friday, at the Extension Study Center, North Campus, University of Oklahoma, Norman, Oklahoma.

A principal feature of this meeting will be displays of water well materials and demonstrations of equipment by manufacturers and suppliers. The meeting place provides plenty of room both inside and outside for exhibits.

The program prepared has at least nine speakers on a number of subjects all of interest to drillers. It is so arranged that there will be no talks during the special periods for viewing the exhibits and demonstrations. Mayors and City Managers will be invited to the meeting, which with the drillers in attendance should make this meeting one of the largest and best up-to-date.

Mr. Marvin Baker, Vice-President, has been elected President to fill the unexpired term of Bill Wallace who resigned in June. The new president is from Oklahoma City. Details regarding the program and arrangements can be secured by writing Mr. L. J. Clarke, Secretary, c/o State Department of Health, Oklahoma City.

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MISSISSIPPI MEETING

The directors of the Mississippi Association are planning on their annual meeting to be held at the Buena Vista Hotel in Biloxi on November 18.

A business meeting will be held at 10 a. m. with luncheon at 12:30 p. m. and a second business meeting at 2:00 p. m. It is expected to have a conservation bill ready for discussion, also one prominent speaker on a subject of interest to drillers. Mr. Fred Sutter, P. O. Box 156, Pass Christian, is Secretary of the association.

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FLORIDA MEETING

The annual meeting of the Florida Association was held in Orlando, July 5, at the Lamar Hotel, with President J. P. Carroll presiding. Several new members were received and reports of officers were submitted.

The election of officers resulted in R. M. Vickers, Miami, becoming President; J. L. Knight, Vero Beach, First Vice-President; L. E. Owens, Jacksonville, Second Vice-President; Clyde Freeman, Orlando, Secretary; Don Partridge, Jacksonville, Treasurer. As Directors, Mr. J. P. Carroll, West Palm Beach; Alonzo Joyce, Callahan; A. O. Dunlap, Dunedin, and Mrs. J. Hinckley, Tampa. The next quarterly meeting will be held the first Saturday in October (4th) at the Lamar Hotel in Orlando.

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SOUTH DAKOTA MEETING

At the invitation of the South Dakota Well Drillers Association, the water well drillers of South Dakota, together with their employees, families, and friends had an informal gathering and picnic at Ruskin Park near Forestburg on Sunday, August 24. Counting the children about two hundred and fifty people were in attendance.

Free food, pop, beer, and ice cream were provided for the group with entertainment suitable for all. The meeting was so popular and such a success that it was voted to make it an annual affair.

—o—

MONTANA MEETING

The 1952 convention of the Montana Association was held at Missoula as scheduled. Bozeman was selected as the 1953 convention city.

During the two-day meeting the

Studebaker Drilling Company operate in the area of El Cajon, California drilling mostly irrigation wells. The picture is of a10-inch well for a dairy farm. It is being pumped at 175 g.p.m.

Mr. Joseph Viera operating the Viera Well Drilling Company in the area of Portsmouth and Newport, Rhode Island has been drilling wells over 20 years, mostly 6-inch holes for farms and homes.

(Continued from Page 12)

following officers were elected for the ensuing year: Virgil Mowbray, Missoula, President; Kenneth Thompson, Wibaux, Vice-President; Boone Whitmer, Circle, Secretary-Treasurer; Harry Van Dyke, Bozeman, four-year Director to succeed Axel Livingston, Winnett.

—o—

CALIFORNIA MEETING

The 4th annual meeting of The Associated Drilling Contractors has been set for September 12 and 13 at Hoberg's Restaurant about 100 miles north of San Francisco on Clear Lake, Lake County, California.

A fine program of speakers has been arranged and several manufacturers plan on having their products on display. It is hoped this meeting will bring out a large number of drillers from California and surrounding states. Mr. Donald E. Engels is Secretary.

—o—

CALIFORNIA MEETING

The Water Well Drillers Association of Southern California will hold their meeting on Friday, October 3, at the Alexandria Hotel in Los Angeles. The ladies are invited for this meeting which will not lack for speakers and entertainment. Mr. Tom Carroll, Temple City, is Manager of the association.

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VIRGINIA MEETING

The annual meeting of the Virginia Water Well Drillers Association will be held at the Virginian Hotel in Lynchburg, November 14 and 15. Details of the arrangements can be obtained by writing Mr. Jack Sundquist, Secretary, P. O. Box 1568, Norfolk, Virginia.

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MINNESOTA MEETINGS

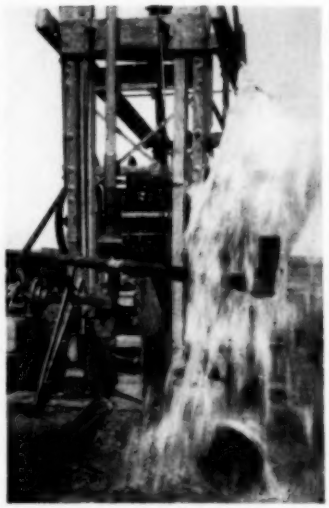
The Minnesota Association annual meeting will be held March 26, 27, and 28, 1953, at the Nicollet Hotel in Minneapolis.

In the meantime, R. R. Howell Company of Minneapolis held open house September 26 at their Mankato plant for the drillers of southern Minnesota.

December 6, 1952, Lindsay Bros. will entertain Minnesota drillers at their office and warehouse in Minneapolis.

Several district meetings will be held prior to the annual meeting for the discussion of a proposed license law.

Mr. Norm Ovrum, Executive Secretary, 1495 W. Larpenteur Avenue, St. Paul 8, Minnesota, can furnish details of these meetings.



An 8-inch well drilled by R. I. McCutcheon of Havre, Montana for the Elks Country Club pumping 220 g.p.m. with 4 feet of drawdown. A 12-foot screen was used in the well and surged and developed to produce the yield.

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KANSAS MEETING

The Kansas Water Well Drillers Association will hold its 5th annual convention at Lawrence, Kansas on December 12 and 13, 1952, at Lindley Hall, University of Kansas. Details regarding the arrangements can be secured by writing Mr. D. W. Berry, for the Service Secretary, at the above address.

DRILLERS NOTICE

We need pictures. If you would like to have a picture of your outfit shown, please send us either a glossy print or a negative. It will be returned, if you wish.

EDWARD E. JOHNSON, INC.
2304 Long Avenue
St. Paul 14, Minnesota

SILT, SAND AND GRAVEL

(Continued from Page 11)

Arkansas, and Platte Rivers. The broad flat sheets of sand and gravel found in western Nebraska, North and South Dakota, eastern Montana and Wyoming are good examples of this type of sand and gravel deposit.

Swamp sediments are usually poor yielders of water, though some peat and coal beds may be permeable. Lignite beds in western North and South Dakota and eastern Montana provide water for many wells. Delta deposits consist mostly of fine sand, silt, clay and vegetable matter. Where made up of sand, they can be developed as sources of ground water, as indicated by the large number of wells in the Mississippi River delta.

The most widespread and continuous water producers are the marine sediments, such as the sandstones of eastern and southern Wisconsin, Illinois, and Iowa. The St. Peter sandstone of the north-central states is probably the best known aquifer in the United States. Marine deposits in Florida and Georgia yield many millions of gallons of water daily, to say noth-

(Continued on Page 15)

A 6-inch well 189 feet deep in northern Michigan had an artesian pressure of 19 pounds when completed by W. J. Rodgers of Gulliver, Michigan.

ADVERTISEMENTS

We will insert advertisements for drilling equipment wanted or for sale, help or work wanted, etc., for our readers, free of charge. Advertisements must be brief, and we cannot assume responsibility for them, but will be glad to put parties in touch with each other by this means and suggest that they investigate any offers or inquiries carefully for themselves.

FOR SALE: Worthington Vertical turbine pump with right angle drive and Witte diesel engine; pump has 25 foot setting and is designed for 425 g.p.m.; engine is complete with all gauges, controls, etc. Equipment never used; was built for export customer who counld not obtain import license. It is offered in New York for sale complete as is for $800.00. For further information, write: W. Van Doorn, Export Division, Worthington Corporation, Harrison, New Jersey.

FOR SALE: Failing 1000 ft. capacity truck mounted rotary, complete, also Sullivan 1000 ft. capacity drill. Write: Fred E. Butler, Box 1832, Casper, Wyoming.

FOR SALE: A No. 4 special Clipper drilling machine, 40 h.p., Beaver motor, steel mast, cat-tractor driven; in good condition. If interested, write: Mrs. Beryl Howell, 5705 Auburn Avenue, Sciotoville, Ohio.

FOR SALE: One 5½ Keystone Joplin special drilling machine powered by Waukesha gasoline motor; has some sand and drilling line; all extra parts to go with the machine. Write: Leon Oakes, Route 2, Marshalltown, Iowa.

FOR SALE: Failing truck mounted rotaries, 1000 ft. and 1500 ft. capacity, complete, tools, drill rod, etc. Write: Fred E. Butler, Box 1832, Casper, Wyoming.

FOR SALE: Repossessed practically new 1950 Ideco No. 16 on 1945 GMC 6x6 truck driven only 10,322 miles. Bargain at $4000.00 cash. Write: Southern Pipe and Supply Company, 630 W. Church Street, Orlando, Florida.

FOR SALE: One 22W Bucyrus-Erie drilling machine mounted on 1941 Ford truck; machine is equipped with derrick hoist, spooling device, casing reel, etc.; machine and truck in good condition, ready to go. Write: Hoeg & Ames, Lincoln, Iowa, Phone 23 F 4.

FOR SALE: 1914 feet of 10 in. perforated well casing. Write: The Cooperative Security Corporation, 40 North Main Street, Salt Lake City, Utah.

FOR SALE: Gus Pech all-steel boring machine; mounted on International truck, complete with rods, augers, etc. reasonably priced; also Chain type ditch digging machine mounted on Ford tractor, good condition and ready to go. Write: N. A. Larson & Son, Cambridge, Illinois.

FOR SALE: One Worthington Deep Well Turbine pump designed for 500 g.p.m. at 460 ft. TNH, with 440 ft. of 8 in. by 2⅞ in. water lubricated column, with a 100 HP 440 volt 3 phase 60 cycle 1750 RPM hollowshaft US motor; pump used less than two months; priced to sell. Write: City of Lancaster, Lancaster, Wisconsin.

FOR SALE: Reverse hydraulic well rig, practically new; drills 30-inch holes; tools 6 in. drill stem and trucks; ideal for irrigation wells; also reverse hydraulic well rig for making tests and stock wells; 4-in. drill stem. Write L. M. Sharp, Sidney, Nebr.

Martin Sundin of Viscount, Saskatchewan drilling test holes through the ice on the South Saskatchewan River. This was a government project which required all one winter to complete.

FOR SALE: One Howell No. 120 well drilling rig mounted on '39 two-ton Chevrolet truck; casing reels and 500 feet of ⅝ in. cable and 500 ft. ⅜ in. cable; 3 in. x 4 in. drilling tools with rig; also 5 and 6 in. drilling tools and 10 in. bits. Write or telephone Millard Gilman, Route 11, Minneapolis, Minnesota, telephone Orchard 8608.

FOR SALE: 1949 No. 440F. Cyclone machine, truck mounted, god shape, for $5,150.00; 20-W Bucyrus truck mounted, lines, 4 in. x 6 in. tools for $2,975.00; Good 240 Star with tools and lines, truck mounted, for $1,775.00; 240 Star with new power unit, reconditioned and painted, truck mounted for $1,950.00. Write: R. R. Long, R. R. 6, Old State Road, Jacksonville, Illinois.

FOR SALE: Drilling rig custom built by mechanical engineer; compares to 21-W; mounted on 2-ton Reo truck; all in A-1 shape; ideal for one man operation; tools for 6 in. and 8 in. hole; price $1,950.00. Have too many machines. Write: Remick Artesian Well & Pump Company, Inc., Rye, New Hampshire.

FOR SALE: Slim hole portable rotary, mounted on good WHITE truck, a frame 55 ft. derrick, made of 3½ heavy drill pipe, reinforced; Wheatley 6x6 pump Mission fitted, driven with Minn.-Moline 50 H.P. new engine two-drum American hoist driven by 35 H.P. Minn.-Moline engine, also drives Weise rotary table; 3½ x 26 ft. square Kelley with 400 ft. approx. of 3½ x 20 ft. long drill stem, 6¼ in. x 20 ft. drill collar with extra collar same size 10 ft. long for added weight; lot of 8⅝ and 5¾ Hughes tricone hardrock bits, hoses, subs, Halliburton Mud-mixer, mud tanks all complete ready to go with small tools. Cash f.o.b. Delafield, Wisconsin, $7,500.00. Write: F. M. Gray, Jr., Gray Well Drilling Company, Delafield, Wisconsin.

FOR SALE: Keystone model 70 all steel well drill mounted on 1939 Ford truck with two speed rear axle and 8:25x 20 tires, 16 foot x 4½ inch stem, swivel sockets, two 6 in. bits, bailer, wrenches, bar and chain tool tightener, ¾ in. drill line, ⅜ in. sand line, Waukesha power unit on rig; everything in first-class condition for $2000.00 cash. Write W. E. Hubler, c/o F. J. Hubler & Sons, Port Royal, Pa.

FOR SALE: Complete drilling outfit, one all-steel trailer mounted shop built geared rig swings 1600; one Thriftmaster Chevrolet flat bed truck 1947, run less than 40,000; One factory built engine driven Lincoln welder 200 amp on two-wheel trailer and all the tools you need 6 in. to 14 in. for hard drilling; cash price $2,500.00, f.o.b. Los Banos. Write: Charles E. Marchese, 439 Eye Street, Los Banos, California.

FOR SALE: One used drill bit joint size 1⅝ in. x 2½ in. x 8 threads inch 2½ in. wrench square about 3 ft. 6 in. long, also a new 4½ in. drive shoe. Write: J. M. Suheski, Crystal Falls, Mich.

FOR SALE: No. 16 Ideco Drilling Machine, two years old, with rubber shock absorber, electric starter, casing reel and spooling device, 36′ derrick with power hoist. 475′ of ⅝″ drill cable and 475′ of ⅜″ sand line. Mounted on 1947 Chev. two-ton truck. Will sell with or without truck. Exceptional value. Will sell reasonably for quick sale. Contact Guy Beemer, Lakota, Iowa.

FOR SALE: No. 10 Ideco Drilling Machine, two years old. Motor and machine in A-1 condition. Mounted on 1942 GMC 1½ ton truck with new 1946 motor. Well machine has 36′ derrick with power hoist. Also 500′ of ⅝″ cable and 500′ of ⅜″ sand line. Will sell reasonably for quick sale. Contact Howard White, 1131 Cornwall St., Waterloo, Iowa.

(Continued from Page 14)

WANTED: One combination slip socket to work in 8" hole to use on pin collar 2½ x 3½ A.P.I. joints, bells to fit 8-12" hole; one 6" bit 2½" x 3½" A.P.I. joint; one 8" bit 2½" x 3½" A.P.I. joint; one 10" Spudding bit 2½" x 3½" A.P.I. joint; one 12" bit 4" x 5" A.P.I. joint—800 to 1000 lbs. Write: Philip Morrill & Son, P.O. Box 142, Brandon, Florida.

DRILLERS WANTED: Want experienced drillers and helpers in rotary drilling for foundation exploration. Positions permanent. Contact Toledo Testing Laboratory, 1810 North 12th St., Toledo, Ohio.

FOR SALE: Well driller's pipe, 300 feet 3" and 4" standard black pipe threads and couplings. Write: Box LO, c/o Edward E. Johnson, Inc., 2304 Long Avenue, St. Paul 14, Minnesota.

JOB WANTED: Experienced well driller, thirty-one years old, now in Jamaica, wishes job with American drilling firm in order to secure experience in drilling and installation of pumps; will stay with employer three years if agreeable. If interested, write: Box CT, c/o Edward E. Johnson, Inc., 2304 Long Avenue, St. Paul 14, Minn.

FOR SALE: A No. 71 Speed Star, mounted, A-1 condition, complete with tools, dog house on trailer. Write: Kenneth D. Tyson, Box 121, Rudolph, Ohio.

FOR SALE: New and used pipe and casing 5" to 6¼" I. D. Write: Thom. Scheuren, 933 Fern Avenue, Reading, Pennsylvania, or telephone: Reading 41287.

FOR SALE: 6" tools; 1 drill bar 3½" x12'; set of jars, solid rope socket; 1 drill bit; two wrenches, all in good condition; also 3" tools; 1 drill bar 2½"x16'; 2" wrench square, 1 socket and 1 drill bit. Any reasonable offer will be accepted. Write: August Krueger, 936 N. Ninth St., Manitowoc, Wisconsin.

FOR SALE: One hook wall packer for 5⅝" casing. A bargain at $65.00; one steam engine; one temper screw for 1½" rope; one Deming hydraulic ram like new, at $65.00; one 30 horsepower oil country boiler mounted on chain mounting. Write: Arthur H. Cameron, R. D. 3, Alliance, Ohio, or telephone George Cameron, 8-2236, Alliance, Ohio.

FOR SALE: Complete well drilling business and equipment to drill wells 5 to 12"; 45x100 ft. warehouse and office. Established here for 27 years and doing good business. Must sell because of poor health. Write: F. E. Mead Well Drilling Company, 1214 11th Avenue North, St. Cloud, Minnesota.

FOR SALE: One Bucyrus-Erie drilling rig with wooden derrick mounted on International truck with or without 4" and 5" tools; rig ready for work. Write: F. E. Johnston, Valley Drilling Company, 393 Cambridge Street, Ottawa, Ontario, Canada.

JOB WANTED: Indian driller has worked in responsible post ten years in water well drilling line. Wants steady job. Ready to work in any place in the world. Write: P. C. G. Mozumdar, 178, Urban Colony "Habra", P. O. Tababaria, Dist.: 24 Parganas, West Bangal, India.

FOR SALE: Good paying well drilling business for sale in its entirety. Year round operation; big heavy duty, 1,000 foot rotary rig and all accessories including shale shaker; 215 CFM air-compressor; arc outfit and test pump; priced right for quick sale. Call or write: H. C. Todd, 105 Crandall Way, San Luis Obispo, California, Telephone 2415W.

FOR SALE: One Myers self-oiling pump head for deep well; 12" stroke, V-belted to 5 H.P. Century motor; this looks like it is not over a year or two old and working good, operated at 20 g.p.m.; one set of new ash pump rods (2"), approx. 300 feet, never used with malleable connectors, will sell at ⅔ cost of new which run right at $99.00 per hundred feet; also two sets pump rods same as above; one set in well and one used set on hand; you pull rods in well and I will give you the old set free along with set in use now. Write: Citizens Coal and Ice Company, Mattoon, Illinois.

WANTED: Cable tool driller, must be able to weld, steady job, good pay. Write: Gerald E. Foster, 827 Broadway, Sonoma, California.

WANTED: Experienced water well driller, sand, gravel formations. Applicant must have initiative and ability to get ahead. References required. Write: Donald J. Roe, P. O. Box 211, Vandalia, Ohio, or phone Vandalia 44514.

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Some people can stay longer in an hour than others in a week.

SILT, SAND AND GRAVEL

(Continued from Page 13)

ing of the highly permeable limestones found in that area.

Well drillers can obtain information as to the sedimentary deposits in their locality by consulting their state geologist.

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A recruit was on guard duty for the first time. The commanding officer came along and the rookie halted him. The officer indentified himself and proceeded. When he was a few paces away the sentry halted him again.

"What's the idea?" growled the officer. "I just identified myself."

"I have my orders," replied the rookie. "I'm supposed to holler 'Halt' three times and then fire. You're on your second halt."

—o—

Little Johnny's mother had just presented the family with twins, and amid the great excitement, father said that he was sure that teacher would give Johnny a day's holiday in celebration. That afternoon, Johnny came home radiant. "I don't have to go to school tomorrow," he announced. "Did you tell your teacher about the twins?" asked the father.

"No, I just told her I had a baby sister, I'm saving the other for next week."

Mr. P. J. Sweeney of the Geological Survey of New Zealand designed and built the rig shown in the picture, which he operates on survey work in Southland, New Zealand.

DOING THE JOB BETTER

Almost everybody enjoys hunting, with or without a dog. But in most cases, having a dog with you lets you get the birds quicker and easier, and saves many that would otherwise get away.

In that respect, hunting is very much like well drilling: in some cases you could "get along" without a screen for your sand and gravel wells, but using a quality screen helps you do a job better and easier, and do a job which really LASTS.

The Johnson Well Screen is the standard of the world. It is used today in every country of the civilized world where the best is specified.

The Johnson Well Screen makes poor wells good — and makes good wells better.

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